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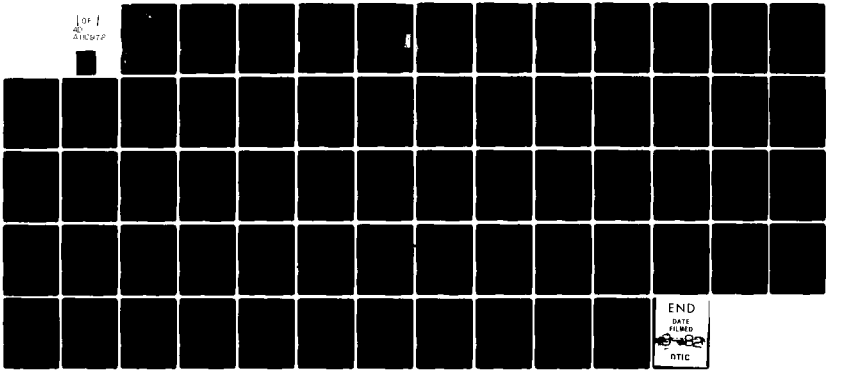

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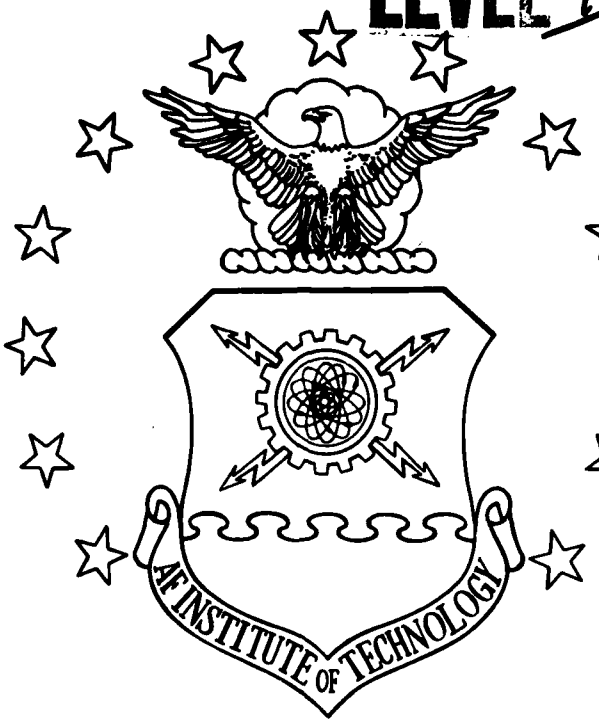

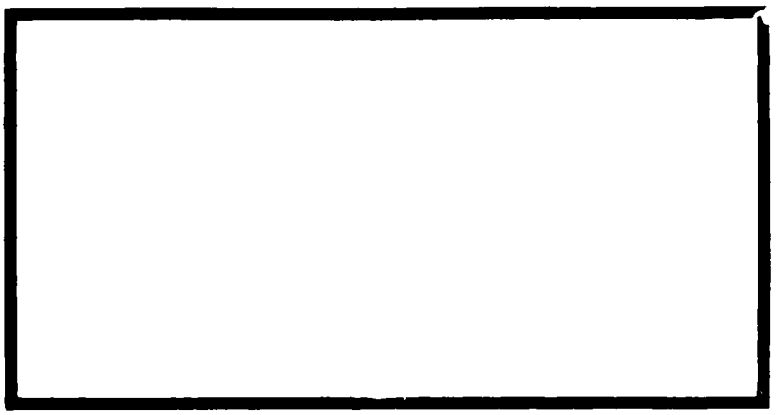

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Wright-Patterson Air Force Base, Ohio

AN ANALYSIS OF RESIDENT SATISFACTION WITH MILITARY FAMILY HOUSING AT THE PROPOSED MX MISSILE SYSTEM SUPPORT BASES

Max L. Proctor, Captain, USAF

LSSR 96-81

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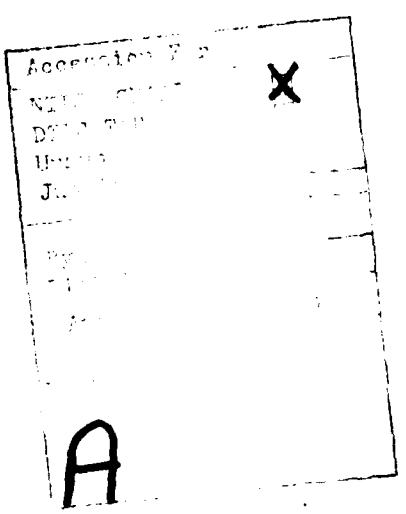

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AN ANALYSIS OF RESIDENT SATISFACTION WITH MILITARY FAMILY HOUSING AT THE PROPOSED MX MISSILE SYSTEM SUPPORT BASES

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science In Engineering Management

By

Max L. Proctor, BS
Captain, USAF

September 1981

This thesis, written by

Captain Max L. Proctor

has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN ENGINEERING MANAGEMENT

DATE: 30 September 1981

COMMITTEE CHAIRMAN

READER

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CHAPTER 1

BACKGROUND STUDY

Topic Description

The effect of housing on American people has recently been the subject of many studies and the topic of much debate among civic and other groups interested in the quality of American life. The vast majority of the housing studies have dealt with the social problems that occur in the blighted urban areas of the nation's larger cities and the sprawling suburban communities such as those found in the Los Angeles area. These studies are very useful when dealing with the redesign and renewal of existing neighborhoods and can be of use in designing completely new communities. Although there are few opportunities to design and build new communities, the United States Air Force has the opportunity to build two at the MX weapons system operating bases.

The purpose of this study is to identify and prioritize a set of variables that might affect resident satisfaction and the quality of life in military family housing at the MX bases. The list of variables recorded in Chapter 2 was identified by the author using personal knowledge and training, interviews with residents in base housing, and library research material. This list of variables

is not purported to be exhaustive.

The prioritized list of variables contained in Chapter 3, Analysis of Data, can be used by the architect/planner who will design the housing units to be built at the MX bases. The need for this information was identified in the MX Operating Bases Conceptual Planning study done by EDAW, Inc. (2:62).

This thesis assumes that resident satisfaction with military family housing affects the morale and welfare of the personnel living in military family housing. It also assumes that resident satisfaction will in turn affect the overall Air Force mission. Therefore, the results of this thesis contribute substantially in the design effort to insure that the Air Force does not make a potentially serious error which would subject thousands of people to housing that is not satisfactory to them.

The Air Force has not undertaken a project of this scale in the Continental United States in many years. During these years, there has been a proliferation of scientific literature produced on the effects of housing on the lives of its residents. This literature is an extremely valuable source of information and should be applied in the design of the MX base military family housing. The most meaningful studies are summarized in the next section.

Literature Review

A comprehensive listing of studies related to housing was published in 1978 by Kenneth R. Tremblay entitled, Toward a Sociology of Housing: A Working Bibliography. This document was very useful in identifying completed housing studies through 1978. Literature since 1978 was researched using standard library research methods.

There were no studies being conducted by the United States Air Force, as of May 1981, on general housing condition improvements. Air Staff personnel in LEEH confirmed that the last study was completed in 1977 and was conducted by Raymond, Parish, Pine, Weiner & Plovnich of Washington, D. C. and Tarrytown, New York, entitled, U. S. Air Force Family Housing Communities: Guidelines for Environmental Improvement. The guidelines attempted to explain how to analyze the environmental strengths and weaknesses of family housing areas and how improvements outside the actual living quarters could increase the housing area's livability. Raymond (3:1) defined livability as a reaction to three key variables:

1. Create a sense of identification and belonging with the home, street and neighborhood for each family.

2. See that the housing area meets the needs of its occupants.

3. Make the housing area attractive and a source of pride.

The guidelines did not deal with the interior design fea-

tures nor the actual physical design of homes but rather dealt with improvements to existing housing areas. This study has been used to improve existing military family housing areas by providing a solution package that could be applied to any Air Force base.

The guidelines were somewhat successful in identifying several potential key problem areas that should be considered in any design of a base living environment. The guidelines asserted that the three variables influence resident satisfaction and livability.

One of the most comprehensive studies done on housing and its affect on individual satisfaction was completed in 1977 entitled, Environmental Choice, Human Behavior, and Residential Satisfaction, by William Michelson, University of Toronto. The study was conducted over a five year period using data made available from people who moved in the city of Toronto.

This study analyzed the motives for family moves from one dwelling to another. The specific types of housing studied were high density downtown apartments, suburban apartments, downtown single family houses, and suburban houses.

Michelson's research team used surveys, personal interviews, and telephone canvassing to determine and evaluate specific variables associated with satisfaction and

dissatisfaction with the housing types. The variables concerned size of living space, aesthetics, convenience, equipment, location, recreation, and freedom of choice. Michelson attempted to identify major themes that could be used to create better apartments, houses, and residential areas.

Michelson listed four prominent themes from his research. The first theme was that despite an observation of a general level of satisfaction in high-rise apartments, a number of problems exist such as soundproofing, storage space, living area, and the number of rooms available to a given family. Beyond these initial physical problems, the apartment dweller felt that he was unable to remedy problems without moving. Additionally, the occupant became increasingly upset over the escalation of monthly housing costs.

The second theme is that certain aspects of high-rise projects such as recreation facilities, mixture of land uses, and a high level of servicing were of critical importance to high-rise dwellers. Recreation facilities for both adults and children were a major attraction in the rental apartments as were a mixture of land uses often found within and adjacent to apartment complexes. A higher level of servicing, e.g., shopping, recreation, and centralized maintenance was shown to be easily traded off in favor of individual suburban type housing. This theme indicated that many people aspire to individual housing.

The third theme, found among families in suburban housing, pertained to dissatisfaction with access to places of recreation. Housewives felt a distinct sense of isolation and remoteness, which Michelson believed led to a great increase in the percentage of suburban wives who undertook employment outside the home. Interestingly, the feelings of remoteness did not make the suburban house dweller want a mixing of land uses such as commercial or industrial intermingled with residential because of the fear that property values would go down.

The fourth theme identified from the study concerns the individual houses in and near the downtown areas. The data indicated without ambiguity that families living in houses in the downtown area found them highly attractive because of the location. These families were extremely satisfied and loyal to their type housing not only because of their proximity to all types of activity but also because they were living in the housing type to which they aspire. They had no intention of moving.

The study demonstrated that despite some negative features in all types of housing, most families were at least minimally satisfied with it. It also suggested that not only physical aspects of housing were important but also that self-selection of housing was an important factor.

Joseph DeChiana and Lee Koppleman published a Manual of Housing/Planning and Design Criteria in 1975. Por-

tions of the housing studies were based upon the 1970 census report. DeChiana and Koppelman dealt with general planning considerations, neighborhood organization, community facilities, site considerations, types of housing, and types of apartments. The study developed heuristic models for each area of interest. Many general guidelines were asserted in this publication.

The first section of the book was devoted to corrective actions necessary after urban blight has occurred. DeChiana and Koppelman (1:46) also named four basic objectives in producing sound neighborhoods:

1. Good planning and zoning.
2. Community centers and open space.
3. Good governmental services.
4. Integration.

The second section dealt with general planning considerations. For example, they listed, in tabular form, the compatibility of housing with other land uses and the maximum acceptable distances to various activities such as work, school, community facilities, cultural facilities, and recreational facilities. Factors such as pollution, residential densities, and land use intensity were also discussed.

The next three sections discussed neighborhood organization, community facilities, and site considerations, respectively. The last of the three sections which discussed site considerations was extremely valuable in identifying

variables used in this research.

The last two sections gave examples of types of housing units and identified several general design criteria. This section was also very useful in identifying variables.

Statement of the Problem

Inadequate or poorly designed military family housing is the subject of considerable criticism among occupants. At most installations, however, personnel have an opportunity to choose their living accommodations. For example, a person can normally opt to live off base in rental houses or apartments or he may choose to buy a house on the local market. It is suggested that this option allows personnel to live with the conditions that exist in military family housing areas without severe morale damage.

The situation at the MX operating sites will not offer that option to personnel initially because of the lack of available off base housing and the remote siting of the proposed locations. Current restrictions on housing civilian employees in government housing facilities will cause the civilian market in the selected areas to be overloaded, in turn further restricting military personnel from competition in the very scarce and distant housing market.

This restriction would force the use of mandatory.

assignment of military family housing units to military personnel. The author believes that this policy would cause morale problems with personnel who would rather live off base. These problems, however, could be ameliorated by providing the best possible military family housing.

This thesis will evaluate some aspects of the physical environment that affect resident satisfaction with military family housing at the proposed MX operating bases. The variables will be prioritized according to their relative importance to resident satisfaction. This prioritization will yield guidelines that can be used by the designer to eliminate or reduce the level of dissatisfaction with the physical aspects of housing at the MX operating bases.

Research Questions

This research will answer the following questions:

1. What aspects of military family housing are most important to the residents of that housing?

2. Which aspects of military family housing should the architect/designer concentrate on?

3. Which aspects of military family housing should the Air Force put money into?

CHAPTER 2

METHODOLOGY

Introduction

The author used personal knowledge, personal training, professional opinion, interviews with current residents of base housing, and library research material to identify the following 58 separate variables that indicated significant affect on resident satisfaction in the proposed MX base housing. The variables are listed below along with a random number that was used for identification purposes. The variables are:

1. Medium density (multi-family) compared to high density (high-rise) dwellings
2. Auto traffic patterns
3. Low density (single family/duplex) compared to medium density (multi-family) dwellings
4. Air conditioning
5. Washer/dryer hookups
6. Freedom to choose type housing (Type housing meaning single units, duplexes, fourplexes, apartments, townhouses, high-rise, or garden houses)
7. Ceiling/wall finishes (Use of different materials and or textures in ceiling and walls versus smooth finished sheetrock)

8. Proximity to children's playground (Within walking distance)

9. Privacy fencing (Partial blind fencing to give semi-privacy for sun bathing, etc.)

10. Floor finishes (Use of carpet, wood floors, or linoleum versus asbestos tile)

11. Bath equipment (Necessity for more than minimum such as exhaust fan, shower enclosure, sun lamp, whirlpool)

12. Interior color scheme (Use of color within the integral design versus use of neutral colors)

13. Number of bedrooms

14. Proximity to mass transit system (Within one or two blocks)

15. Kitchen equipment (Quality of range, refrigerator, vent-a-hood, etc.)

16. Off street parking

17. Noise transmission from dwelling to dwelling

18. Size of living room

19. Exterior building finishes (Brick versus metal siding versus wood siding versus stone versus block, stucco, etc.)

20. Exterior color scheme (Bright or hard colors versus earth tones)

21. Shape of building (Three dimensional appearance of structure)

22. Area landscaping (Meaning neighborhood land-

scaping including clusters of large trees, tree lined streets or simular landscaping that is neighborhood centered)

23. Private green area (Need for a conventional yard)

24. Available off street bike trails

25. Size of bedrooms

26. Shaded areas (Such as covered patio or large tree in individual yard)

27. Private patio space (Paved area adjacent to individual units for use as barbecue area, etc.)

28. Easy maintenance provisions (Design features that allow easy repair and maintenance of structure or equipment)

29. Garage/carport

30. Sufficient hot water

31. Proximity to work place (Within walking distance)

32. Proximity to junior high or high school (Within walking distance)

33. Proximity to sporting facilities (Within walking distance to softball fields, tennis courts, basketball courts, etc.)

34. Number of electrical outlets

35. Separation from airfields

36. Curtain equipment (Traverse rods, etc.)

37. On street parking (Allowed versus not allowed)

38. Arrangement of rooms

39. Outside storage space

40. Quality construction (Sturdy, well insulated, weather tight, energy efficient)

41. Separation from industrial activities

42. Ceiling lights (As opposed to switched plug for lamps)

43. Number of bathrooms

44. Proximity to elementary school (Within walking distance)

45. Proximity to BX and Commissary (Within walking distance)

46. Proximity to picnic areas (Within walking distance)

47. Proximity to large green areas

48. Proximity to off base shopping (Within walking distance)

49. Kitchen pantry

50. Cabinet space (More than minimum in kitchen)

51. Window shades

52. Proximity to medical facility (Within walking distance)

53. Closet space (More than bare minimum)

54. Proximity to chapel/ churches (Within walking distance)

55. Private landscaping (Planned vegetation around individual units)

56. Outside exposure (Small versus large windows)

57. Size of kitchen

58. Size of dining area

This study proposes that these variables affect a resident's satisfaction in housing to varying degrees and that these variables can be prioritized in order of importance to yield a design guide which can be used by the architect/designer. With this list of variables prioritized, the architect/designer may concentrate his design efforts on the most important variables. This will result in the most satisfactory dwellings being built by meeting the level of satisfaction acceptable to the residents.

Research Model

The research model chosen to evaluate these variables is the Q-sorting model as presented in Chapter 3 of William E. Souder's Management Decision Methods. The model states that a list of activities can be prioritized by using a system based on the relative worth of each activity.

The basic model calls for the separation of the activities into an odd number of categories based on the number of items to be sorted. The example recorded in Souder's work has five final categories but explains that the process can be expanded to more categories. The basic

model has been modified according to Figure 1, which yielded nine final categories.

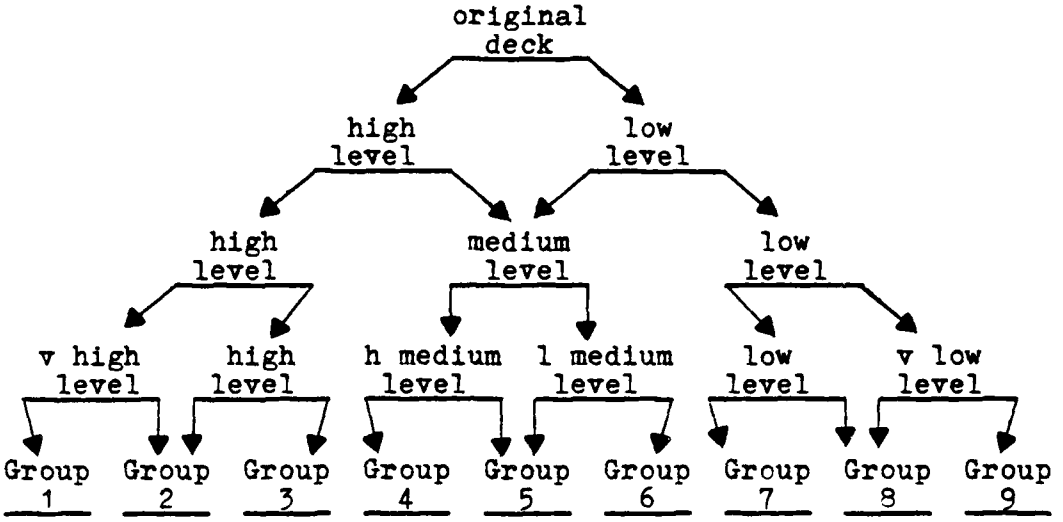


Figure 1

Q-Sorting Model

The model was further expanded to yield an overall sequential priority to all the items by having the participants prioritize all the items within each category. This procedure yielded a rank ordered list of variables with positions from 1-58. This data was used to obtain a median rank for each variable.

Measurement Devices

Seven participants were selected to perform the Q-sorting procedure. The seven participants comprised a convenience sample of experts in the housing design field.

Five military architects, one family housing manager, and one instructor in the School of Civil Engineering, Air Force Institute of Technology, who teaches the management course for housing managers were selected. Every participant evaluated each variable and assigned relative values and priorities to each variable according to their professional judgement in relation to resident satisfaction. The results of the Q-sorting procedure are contained in Appendix B and Appendix C and discussed in Chapter 3, Analysis of Data.

The participants in the Q-sorting procedure were given the following instructions and an original deck of cards. Each card listed one of the 58 variables.

1. Using your professional expertise, divide the deck into two piles, one representing a high level of importance to the resident's satisfaction with base housing at the MX bases, the other a low level. (The piles need not be equal.)

2. Select cards from each pile to form a third pile representing the medium level of importance to the resident's satisfaction.

3. Select cards from the high level pile to yield another pile representing the very high level of importance; then select cards from the low level pile to yield another pile representing the very low level of importance to resident satisfaction. Finally, divide the medium level deck

into decks based on medium level worth.

4. Repeat the process in step two within each of the three major levels (high, medium, and low). The category sorting should yield nine categories.

5. Retain the nine categories and prioritize each item within the categories.

6. Finally, survey the selections and shift any cards that seem out of place until the classifications and priority are satisfactory. (Categories need not be equal nor is it necessary for all categories to contain items.)

7. Record the random numbers of each item in priority sequence under the appropriate category.

A copy of the instructions and scoring sheet is included as Appendix A.

Ranking Procedure

The 58 variables were ranked two different ways using the results of the Q-sorting procedure. The variables were ranked first according to the median of the participants' category assignments and secondly by the median of the participants' overall priority. The two ranking methods were compared for association using the Spearman Rank Correlation Coefficient, r_s. The second ranking method was then superimposed on the first method to gain an overall grouping and rank for each variable.

All the steps in the ranking procedure are explained

in Chapter 3, Analysis of Data. The final overall ranking is also presented in Chapter 3.

CHAPTER 3

ANALYSIS OF DATA

Introduction

The results of each participant's Q-sorting procedure yielded two items of data for each variable. These items were a group classification on a scale of 1-9 and a rank order of 1-58. Both items of data were used to obtain a combined rank order and classification for each variable. The following steps were accomplished:

1. Obtain the median group classification for each variable. This step is included in Appendix B.

2. Obtain the median rank order for each variable. This step is included in Appendix C.

3. Establish two rank orders based on the median group classification and the median rank order.

4. The rank orders established in step number 3 were compared using the Spearman Rank Correlation Coefficient to obtain a measure of association.

5. The median rank order was used to rank order each variable within each group to obtain a final rank order and group classification.

Median Group Classification

Appendix B lists all 58 variables with each participant's group classification rating. Each variable was

assigned a group classification rating based upon the median response. An overall ranking was established using the following formula:

$$R_T = \frac{\sum R_1, R_2, R_3, \text{---} R_n}{N}$$

R_T is the resulting rank of all the variables with the same group classification. $R_1, R_2, R_3, \text{---} R_n$ is the rank that variable would have in a rank order. N is the number of variables in the group.

Group one contained eight variables; therefore, the ranks of the variables would be 1, 2, 3, 4, 5, 6, 7, and 8. This data inserted into the above formula yields:

$$R_T = \frac{\sum 1,\ 2,\ 3,\ 4,\ 5,\ 6,\ 7,\ 8}{8}$$

$$R_T = 4.5$$

Thus, each variable in group one was assigned a rank of 4.5.

Group two also contained eight variables. The ranks of these variables would be 9, 10, 11, 12, 13, 14, 15, and 16. This data inserted into the formula yields:

$$R_T = \frac{\sum 9,\ 10,\ 11,\ 12,\ 13,\ 14,\ 15,\ 16}{8}$$

$$R_T = 12.5$$

Each variable in group two was assigned a rank of 12.5.

Ranks for the variables in the remaining seven groups were obtained using the same method. The ranks for all the variables, using this method, are contained in Appendix D under the column labeled Rank X.

Median Rank Order

Each participant's rank and the median rank of the 58 variables are recorded in Appendix C. The variables were assigned ranks from 1-58 based on the median recorded in Appendix C. The variable with the lowest median was assigned rank number 1, the variable with the next lowest median was assigned rank number 2, etc. Ties were resolved using the formula recorded in the previous section.

The ranks for each variable, using this method, are recorded in Appendix D under the column labeled Rank Y.

Measurement of Association

The procedure for using the Spearman Rank Correlation Coefficient is contained on pages 202-213 of Sidney Siegel's Nonparametric Statistics for the Behavioral Sciences. Siegel (4:212-213) lists five steps in the procedure:

1. Rank the observations on the X variable from 1 to N. Rank the observations on the Y variable from 1 to N.

2. List the N subjects. Give each subject's rank on the X variable and his rank of the Y variable next to his entry.

3. Determine the value of d_i for each subject by subtracting his Y rank from his X rank. Square this value to determine each subject's d_i^2.

4. If the proportion of ties in either the X or the Y observations is large, use formula (9.4) to compute r_s. In other cases, use formula (9.7).

5. If the subjects constitute a random sample from some population, one may test whether the observed value of r_s indicates an association between the X and Y variables in the population. The method for doing so depends on the size of N:

a. For N from 4 to 30, critical values of r_s for the .05 and .01 levels of significance (one-tailed test) are shown in Tabel P.

b. For $N \geq 10$, the significance of a value as large as the observed value of r_s may be determined by computing the t associated with that value [using formula (9.8)] and then determining the significance of the value of t by referring to Table B.

Step numbers 1, 2, and 3 were accomplished and recorded in Appendix D.

Formula 9.4 was used to compute r_s in step number 4 because of the large number of ties in both X and Y. The solution sequence for step number 4, above, is as follows:

First, determine the sum of the X^2s.

$$\sum X^2 = \frac{N^3 - N}{58} - \sum T_x$$

$$\sum X^2 = \frac{(58)^3-58}{58} - \left[\frac{(8)^3-8}{58} + \frac{(8)^3-8}{58} + \frac{(7)^3-7}{58} + \frac{(9)^3-9}{58} + \frac{(14)^3-14}{58} + \frac{(5)^3-5}{58} + \frac{(5)^3-5}{58}\right]$$

$$\sum X^2 = 3232$$

The symbol $\sum T_x$ represents the sum of the ties in the X rank. The ties were in Groups 1, 2, 3, 4, 5, 6, and 8.

Next, compute the sum of the Y^2s.

$$\sum Y^2 = \frac{N^3 - N}{58} - \sum T_y$$

$$\sum Y^2 = \frac{(58)^3-58}{58} - \left[\frac{(3)^3-3}{58} + \frac{(3)^3-3}{58} + \frac{(3)^3-3}{58} + \frac{(2)^3-2}{58} + \frac{(3)^3-3}{58} + \frac{(3)^3-3}{58} + \frac{(2)^3-2}{58} + \frac{(2)^3-2}{58} + \frac{(2)^3-2}{58} + \frac{(2)^3-2}{58} + \frac{(2)^3-2}{58} + \frac{(3)^3-3}{58} + \frac{(2)^3-2}{58}\right]$$

$$\sum Y^2 = 3360$$

The $\sum T_y$ represents the sum of the ties in the Y rank. Ties occured at ranks 4, 10, 15, 18.5, 22, 25, 27.5, 30.5, 33.5, 38.5, 41.5, 46, and 52.5.

Finally, the $\sum X^2$s and the $\sum Y^2$s computed above are used to calculate r_s. The $\sum d_i^2$ was figured in Appendix D.

$$r_s = \frac{\sum X^2 + \sum Y^2 - \sum d_i^2}{2\sqrt{\sum X^2 \sum Y^2}}$$

$$r_s = \frac{3232 + 3360 - 1252.5}{2\sqrt{(3232)\ (3360)}}$$

$$r_s = .81$$

The t associated with the value of r_s was computed using formula 9.8 as mentioned in step number 5. This t

was compared to the t values in Table B of Siegel. The calculated t value was well in excess of all values on the chart, which indicated that the level of significance of the r_s was above .0005 with N-2 (56) degrees of freedom. The t calculation is indicated below:

$$t = .81 \sqrt{\frac{58-2}{1-(.81)^2}}$$

$$t = 10.34$$

The Spearman Rank Correlation Coefficient test indicates there is a direct relationship between the two ranking systems.

The Final Ranking

The two ranking methods were combined by retaining the groups indicated in the first ranking method and then ranking the variables within each group using the second ranking method. The results of this procedure yielded a final grouping and ranking for all 58 variables. The final grouping and ranking are as follows:

Group I

1. #13 - Number of bedrooms
2. #17 - Noise transmission from dwelling to dwelling

3, 4, 5, - equally ranked

3 - Low density (single family/duplex) com-

pared to medium density (multi-family) dwellings

6 - Freedom to choose type housing

#53 - Closet space

6. #43 - Number of bathrooms

7. # 4 - Air conditioning

8. # 5 - Washer/dryer hookups

Group II

9, 10, 11 - equally ranked

#15 - Kitchen equipment

#25 - Size of bedrooms

#29 - Garage/carport

12. #50 - Cabinet space

13. # 1 - Medium density (multi-family) compared to high density (high-rise) dwellings

14. #27 - Private patio space

15. #57 - Size of Kitchen

16. #18 - Size of living room

Group III

17. #30 - Sufficient hot water

18, 19 - equally ranked

#16 - Off street parking

#40 - Quality construction

20. #12 - Interior color scheme

21. #23 - Private green area

22. #55 - Private landscaping

23. #44 - Proximity to elementary school

Group IV

24. # 8 - Proximity to children's playground

25. #49 - Kitchen pantry

26, 27 - equally ranked

#35 - Separation from airfields

#39 - Outside storage space

28, 29 - equally ranked

7 - Ceiling/wall finishes

#58 - Size of dining area

30. #14 - Proximity to mass transit system

31. #10 - Floor finishes

32. # 9 - Privacy fencing

Group V

33. #22 - Area landscaping

34, 35 - equally ranked

#26 - Shaded areas

#38 - Arrangement of rooms

36. #31 - Proximity to work place

37. #21 - Shape of building

38, 39 - equally ranked

2 - Auto traffic patterns

#45 - Proximity to BX and Commissary

40, 41 - equally ranked

#20 - Exterior color scheme

#56 - Outside exposure

42. #33 - Proximity to sporting facilities

43, 44, 45 - equally ranked

#19 - Exterior building finishes

#36 - Curtain equipment

#37 - On street parking

46. #51 - Window shades

Group VI

47. #47 - Proximity to large green areas

48. #11 - Bath equipment

49. #41 - Separation from industrial activities

50. #32 - Proximity to junior high or high school

51. #48 - Proximity to off base shopping

Group VII

52. #34 - Number of electrical outlets

Group VIII

53. #42 - Ceiling lights

54. #46 - Proximity to picnic areas

55. #54 - Proximity to chapel/churches

56. #52 - Proximity to medical facility

57. #28 - Easy maintenance provisions

Group IX

58. #24 - Available off street bike trails

CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter will conclude the thesis by examining the meaning of the grouped and prioritized list of variables presented in Chapter 3. First, an overview of the priority system will present conclusions about each group and the priority ranking within each group. Second, an economic model will then be presented to illustrate how the architect/designer can use the information presented in this research. Finally, a recommendation for further research in this area will be presented.

Overview of the Priority System

The final prioritized list of variables presented in Chapter 3 was divided into nine groups. The nine groups were described in terms of their relative importance to resident satisfaction. The group descriptions are:

Group I. This group of variables has the highest level of significance to resident satisfaction. Placement of a variable in this group indicates that the variable must be accomplished or resident satisfaction will be extremely low.

A general observation from this group is that individual privacy and autonomy are critical to resident sat-

isfaction. The variables number of bedrooms, number of bathrooms, and noise transmission indicate an individual's need for privacy within his housing unit. The high ranking of the variables low density (single family/duplex) and freedom to choose type of housing indicates that individuals need to control their living environment. In addition, air conditioning and washer/dryer hookups are mandatory items for resident satisfaction.

Group II. Variables within this group have a very high level of significance. These variables should be given a very high degree of consideration when the architect designs the housing units.

The variables in this group indicate that the size of the living space is extremely important to resident satisfaction. Small bedrooms, kitchens, and living rooms are major problems with residents because they result in congested living space. Garages and private patio spaces are extensions of the living space.

The placement of kitchen equipment and cabinet space into this group indicates that they are major irritants to residents of base housing. The placement of medium density over high density housing in this group indicates that although the resident would prefer single family housing, medium density is much more acceptable than high rise housing.

Group III. This group contains variables that have

a high significance level. These variables should be accomplished to give residents a level of satisfaction that would be considered acceptable. The author believes that exclusion of any items in this group would lead to significant dissatisfaction among residents.

The variables interior color scheme, private green area, and private landscaping indicate that the aesthetic quality of housing is very important to the residents. Small hot water heaters, lack of off street parking, and poor quality construction are also significant irritants. Variable 44 (proximity to elementary school) indicates that residents believe that neighborhood elementary schools are needed. It is interesting to note that this variable is the only one in the first three groups that is concerned with neighborhood interaction. All other variables in the first three groups affect only the actual living unit or the area immediately adjacent to the living unit. This indicates that neighborhood interaction items are generally less important than the items that directly affect the actual housing unit.

Group IV. This group of variables has a high to medium significance level. The author believes that this group offers the first opportunity to the architect/designer to exercise a cost/benefit study. An example of a cost/benefit model is discussed in the next section. These variables are important to resident satisfaction and must

be addressed by the designer so that the best product can be obtained for the amount of money allocated.

No general theme was noticed among the variables in this group.

Group V. This group of variables contains the medium significance aspects of housing affecting resident satisfaction. The variables in this group will be subject to decision making processes such as the cost/benefit study mentioned above because the level of funding associated with housing may dictate that some, but not all, of these characteristics can be incorporated in the housing design. The author suggests that the variables in this group be evaluated by the architect/designer to determine the value of each variable using the cost/benefit model.

It is suggested that these variables are not critical to resident satisfaction. These items would be nice to have but would not drastically affect morale if the items were not included in the design of the housing units. No general themes were noted among the variables.

Group VI. The variables in this group are of medium to low significance. These variables are considered important enough that the possibility of incorporating them into the housing design should be investigated. The architect/designer should perform a cost/benefit study on these variables, also.

It was noted that four of the five variables in

this group were concerned with neighborhood interaction and the fifth was the need for extra bath equipment that is not normally found in base housing.

Groups VII, VIII, and IX. The variables in these groups were assigned a low to very low significance level. Group VII contains only one variable, the number of electrical outlets. The author believes that a standard number of electrical outlets would be sufficient to assure resident satisfaction. The variables in Group VIII should be considered only if they cost very little extra money for their inclusion into the housing design. The single item in Group IX, off street bike trails, should not be constructed unless all of the other items have been incorporated into the design.

As stated before, Groups IV, V, and VI contain the variables about which most inclusion/deletion decisions should be made. The ranking among variables in these groups is very important because it must be used to develop a decision making matrix that is based on a cost analysis. The ranking among variables in Groups I and IX, on the other hand, is relatively unimportant because of their extremely high and low values. The author concludes that the ranking within groups becomes more important as you approach Group V from either end of the entire distribution.

Using the Data - An Economic Index Model for the Designer

The architect/designer, using a scoring model, can evaluate the variables within each group. For example, Group IV contains nine variables which may be assigned a benefit index from the median values contained in Appendix C. These median values could be inserted into the following formula along with an estimate of the cost of adding the particular variable to the housing units:

$$\text{Economic Index} = \frac{\text{Benefits Index}}{\text{Cost}}$$

The resulting economic index would then be used to order the variables with the highest economic index listed first.

The following compares three of the nine variables in Group IV:

Variable	Benefit Index		Cost/unit		Economic Index
#49 - Kitchen pantry	24	÷	$500.00	=	0.048
#58 - Size of dining area	26	÷	$875.00	=	0.030
# 9 - Privacy fencing	32	÷	$200.00	=	0.160

Table 1

Economic Index Calculation

The cost estimates in Table 1 are purely estimates and used only to illustrate the decision method.

Based on these cost estimates, the resulting economic indexes would be used to reorder the three variables.

Of the three variables, number 9 would be accomplished prior to number 49, and number 49 would be accomplished prior to number 58.

It is expected that at this point the architect/designer will consider more limiting factors such as availability of materials and labor, and other construction restraints in finalizing his design variables. For example, two or three variables may show no significant difference after performing the cost/benefit analysis. Should this happen, the architect/designer would use his professional abilities to resolve the differences using other, more traditional, design restraints such as construction techniques, circulation patterns, materials and methods, and functional relationships.

Recommendation for Further Research

Although the rankings determined by this research should be immediately useful to the military housing designer, further research would increase their usefulness. The author recommends that another study be conducted which would survey the actual prospective resident types. This could be accomplished by surveying a random sample of military personnel with dependents within the Strategic Air Command. The survey could be constructed using an accepted measurement system such as a seven point Likert scale as a response to each variable. The results would

be used to validate the findings in this thesis.

Limitations of this Thesis

The architect/designer who uses the information presented in this thesis must be aware that the data was gathered from a convenience sample of United States Air Force experts in military family housing design and is subject to any bias unique to that group of people. The research methods used in this thesis are published and accepted as standard research methods.

The author believes that this research will contribute substantially to the design effort at the MX operating bases. Neither the decision to build the MX Missile System Support Bases nor the actual siting of these bases has yet been made. When these decisions are made, the architect/designer can use this research as a starting point in his design effort. It may also be used by Air Force personnel appointed to monitor and evaluate the architect/designer's contract performance.

APPENDIX A

Q-SORTING INSTRUCTIONS

INSTRUCTIONS

1. Using your professional expertise, divide the deck into two piles, one representing a high level of importance to the resident's satisfaction with base housing at the MX bases, the other a low level. (The piles need not be equal.)

2. Select cards from each pile to form a third pile representing the medium level of importance to the resident's satisfaction.

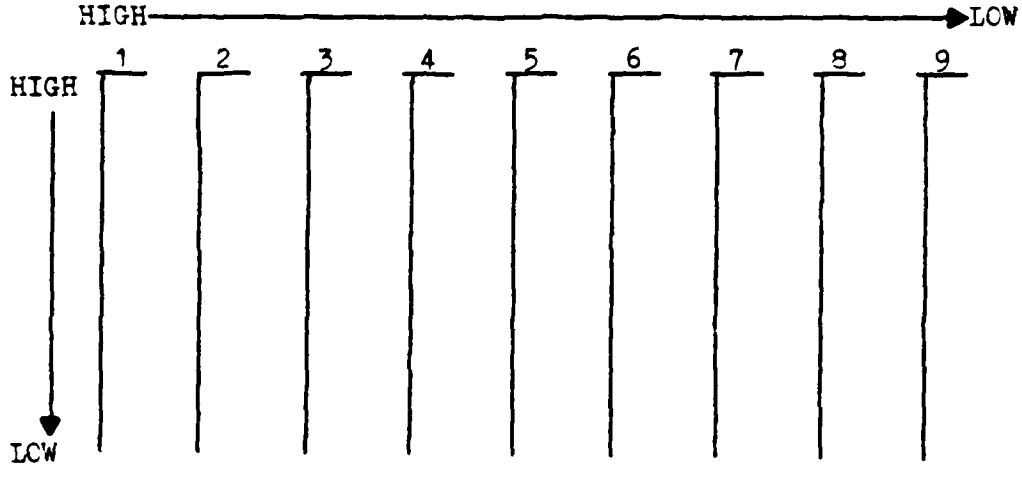
3. Select cards from the high level pile to yield another pile representing the very high level of importance; then select cards from the low level pile to yield another pile representing the very low level of importance to resident satisfaction. Finally divide the medium level deck into two decks based on medium level worth.

4. Repeat the process in step two within each of the three major levels (high, medium, and low). The category sorting should yield nine categories.

5. Retain the nine categories and prioritize each item within the categories.

6. Finally, survey the selections and shift any cards that seem out of place until the classifications and priority are satisfactory. (Categories need not be equal nor is it necessary for all categories to contain items.)

7. Record the random numbers of each item in priority sequence under the appropriate category below.



APPENDIX B

MEDIAN GROUP RATING

Variable	Participant rating							Median
	1	2	3	4	5	6	7	
# 1	8	1	2	2	2	6	6	2
# 2	8	3	3	9	4	9	5	5
# 3	1	1	1	1	7	3	4	1
# 4	1	1	2	2	1	1	1	1
# 5	1	1	2	6	1	2	1	1
# 6	6	1	1	1	5	4	1	1
# 7	6	1	6	3	8	3	4	4
# 8	2	1	4	4	1	4	7	4
# 9	4	2	7	5	3	5	4	4
#10	4	2	7	5	3	5	1	4
#11	8	3	7	4	6	2	8	6
#12	3	1	6	3	7	2	3	3
#13	1	1	1	2	1	1	1	1
#14	6	1	4	5	4	2	8	4
#15	5	2	5	2	2	1	2	2
#16	1	1	3	3	2	3	6	3
#17	1	1	1	1	1	4	5	1
#18	5	2	1	5	1	4	2	2
#19	8	4	7	6	4	5	4	5
#20	9	4	6	8	4	5	5	5
#21	3	9	6	5	4	4	6	5
#22	7	2	7	5	3	8	2	5
#23	2	3	3	3	4	3	1	3
#24	7	9	8	9	9	9	5	9

Variable	Participant rating							Median
	1	2	3	4	5	6	7	
#25	1	1	1	5	2	2	3	2
#26	4	7	8	5	5	1	1	5
#27	2	1	6	4	2	5	2	2
#28	9	9	9	4	8	4	6	8
#29	7	1	3	2	1	5	2	2
#30	5	1	2	3	1	4	4	3
#31	1	1	9	8	5	7	3	5
#32	8	5	9	6	9	1	4	6
#33	5	5	8	4	6	9	5	5
#34	9	8	2	6	8	2	7	7
#35	1	9	3	9	4	2	5	4
#36	1	3	9	7	6	4	8	5
#37	1	4	9	3	5	5	7	5
#38	1	1	5	8	6	7	3	5
#39	2	8	4	7	1	4	1	4
#40	8	1	2	3	7	1	5	3
#41	1	6	2	9	7	2	6	6
#42	8	3	8	8	9	5	2	8
#43	4	1	1	3	1	1	5	1
#44	1	2	3	5	4	1	7	3
#45	1	3	8	7	5	7	2	5
#46	8	6	8	4	8	8	7	8
#47	3	3	6	7	6	6	5	6
#48	4	3	9	9	9	6	5	6

Variable	Participant rating							Median
	1	2	3	4	5	6	7	
#49	5	7	4	4	3	1	4	4
#50	5	1	1	1	2	2	3	2
#51	4	2	8	8	9	5	5	5
#52	9	6	9	7	8	8	6	8
#53	2	1	1	1	1	1	1	1
#54	7	6	9	7	8	9	8	8
#55	1	1	6	6	3	5	1	3
#56	5	4	5	7	7	5	3	5
#57	2	2	5	6	1	1	3	2
#58	3	2	4	6	2	4	4	4

APPENDIX C

MEDIAN RANK ORDER

Variable	Participant ranking							Median
	1	2	3	4	5	6	7	
# 1	54	9	10	6	18	48	47	18
# 2	50	35	22	55	26	57	36	36
# 3	5	7	1	2	43	21	25	7
# 4	9	19	13	9	4	9	2	9
# 5	13	10	12	35	6	5	10	10
# 6	40	3	7	1	36	33	1	7
# 7	41	21	33	16	49	22	26	26
# 8	20	14	26	21	7	25	53	21
# 9	32	32	41	26	20	41	32	32
#10	28	30	40	30	21	43	7	30
#11	51	40	39	24	40	14	55	40
#12	25	20	32	15	46	18	21	21
#13	11	1	2	10	1	4	3	3
#14	42	13	27	32	28	16	56	28
#15	37	27	28	8	13	2	11	13
#16	8	23	18	14	17	24	45	18
#17	4	4	5	3	5	31	33	5
#18	34	25	4	34	11	27	14	25
#19	52	43	42	41	29	44	31	42
#20	55	44	35	50	31	38	39	39
#21	24	58	34	29	30	34	48	34
#22	46	28	43	27	23	52	16	28
#23	22	33	19	12	32	23	6	22
#24	44	57	45	57	58	58	42	57

Variable	Participant ranking							Median
	1	2	3	4	5	6	7	
#25	10	2	6	33	14	13	22	13
#26	31	52	48	28	34	10	5	31
#27	19	12	36	19	16	40	17	19
#28	56	56	58	25	53	32	49	53
#29	43	11	17	7	9	37	13	13
#30	35	16	15	11	3	29	27	16
#31	2	15	54	53	33	51	20	33
#32	47	46	53	38	54	8	30	46
#33	36	45	44	23	41	56	35	41
#34	57	54	14	40	48	17	50	48
#35	1	55	20	56	25	19	34	25
#36	15	34	52	43	42	26	58	42
#37	16	42	51	13	37	45	52	42
#38	12	5	31	49	39	49	18	31
#39	18	53	25	42	12	30	9	25
#40	53	18	16	18	45	11	40	18
#41	3	50	11	58	47	20	44	44
#42	48	39	49	52	57	36	15	48
#43	30	8	3	17	2	6	41	8
#44	6	29	21	31	27	5	51	27
#45	7	36	47	47	35	50	12	36
#46	49	47	46	22	52	53	54	49
#47	26	37	38	44	38	46	38	38
#48	27	38	57	54	55	47	37	47

Variable	Participant ranking							Median
	1	2	3	4	5	6	7	
#49	33	51	24	20	22	3	29	24
#50	38	17	9	4	15	12	23	15
#51	29	31	50	51	56	35	43	43
#52	58	49	55	46	51	54	46	51
#53	21	6	8	5	8	7	4	7
#54	45	48	56	45	50	55	57	50
#55	14	22	37	39	24	42	8	24
#56	39	41	30	48	44	39	19	39
#57	17	24	29	36	10	1	24	24
#58	23	26	23	37	19	28	28	26

APPENDIX D

RANK DIFFERENCES

Variable	Rank X	Rank Y	d_i	d_i^2
# 1	12.5	15	-2.5	6.25
# 2	39.5	38.5	1	1
# 3	4.5	4	.5	.25
# 4	4.5	7	-2.5	6.25
# 5	4.5	8	-3.5	12.25
# 6	4.5	4	.5	.25
# 7	28	27.5	.5	.25
# 8	28	18.5	9.5	90.25
# 9	28	35	-7	49
#10	28	32	-4	16
#11	49	43	6	36
#12	20	18.5	1.5	2.25
#13	4.5	1	3.5	12.25
#14	28	30.5	-2.5	6.25
#15	12.5	10	2.5	6.25
#16	20	15	5	25
#17	4.5	2	2.5	6.25
#18	12.5	25	-12.5	156.25
#19	39.5	46	-6.5	42.25
#20	39.5	41.5	-2	4
#21	39.5	37	2.5	6.25
#22	39.5	30.5	8	64
#23	20	20	0	0
#24	58	58	0	0
#25	12.5	10	2.5	6.25
		47		

Variable	Rank X	Rank Y	d_i	d_i^2
#26	39.5	33.5	6	36
#27	12.5	17	-4.5	20.25
#28	55	57	-2	4
#29	12.5	10	2.5	6.25
#30	20	13	7	49
#31	39.5	36	3.5	12.5
#32	49	50	-1	1
#33	39.5	44	-4.5	20.25
#34	52	52.5	- .5	.25
#35	28	25	3	9
#36	39.5	46	-6.5	42.25
#37	39.5	46	-6.5	42.25
#38	39.5	33.5	6	36
#39	28	25	3	9
#40	20	15	5	25
#41	49	49	0	0
#42	55	52.5	2.5	6.25
#43	4.5	6	-1.5	2.25
#44	20	29	-9	81
#45	39.5	38.5	1	1
#46	55	54	1	1
#47	49	40	9	81
#48	49	51	-2	4
#49	28	22	6	36
#50	12.5	12	.5	.25

Variable	Rank X	Rank Y	d_i	d_i^2
#51	39.5	48	-8.5	72.25
#52	55	56	-1	1
#53	4.5	4	.5	.25
#54	55	55	0	0
#55	20	22	-2	4
#56	39.5	41.5	-2	4
#57	12.5	22	-9.5	90.25
#58	28	27.5	.5	.25
			$\sum d_i^2$	= 1252.5

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